

Executive Summary

It was a down year for U.S. proved reserves in 1998, particularly crude oil reserves. U.S. proved reserves of crude oil fell 7 percent in 1998, the largest percentage decline in 53 years. Inflation adjusted crude oil prices, which began a decline in 1997, plunged by December 1998 to levels last seen in 1935. Falling crude prices led to a drop of almost 60 percent in rigs drilling for oil during 1998, followed by a decline in the number of new and producing oil wells, which was followed by the drop in oil reserves. Only 24 percent of 1998 oil production was replaced by proved reserve additions.

As of December 31, 1998 proved reserves were:

Crude Oil (million barrels)	
1997	22,546
1998	21,034
Decrease	-6.7%
Dry Natural Gas (billion cubic feet)	
1997	167,223
1998	164,041
Decrease	-1.9%
Natural Gas Liquids (million barrels)	
1997	7,973
1998	7,524
Decrease	-5.6%

U.S. dry natural gas reserves declined 2 percent in 1998. This decline broke a 4-year string of annual increases, and offset two-thirds of the gain in the prior 4 years. Natural gas reserve additions in 1998 replaced only 83 percent of gas production.

Proved reserves are those quantities that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. Petroleum engineering and geological judgment are required in estimating proved reserves; therefore, the results are not precise measurements. This report of 1998 U.S. proved reserves of crude oil, natural gas, and natural gas liquids is the 22nd in the annual series prepared by the Energy Information Administration.

Crude Oil

Price matters. Crude oil reserve additions were less than a fifth of those in 1997. Additions would have been even smaller in the absence of a few large, long-term development projects that were continued by their operators in the face of low oil prices. Large revisions associated with property acquisitions and development in some of California's old and heavy oil fields helped that State's reserves to increase.

Changes in proved reserves are impacted by price in several ways. Low prices imply poor economics for oil producers, and poor economics leads to low drilling levels. Only twice in over 100 years have fewer oil wells been drilled than in 1998.

The onshore lower 48 States is a mature exploration and development area where, in the absence of enough exploratory and development wells drilled, it is next to impossible to add sufficient new fields, new reservoirs, and positive revisions to replace production. In the few less mature frontier areas not subject to drilling moratoria, it is still possible to drill very prolific wells that can be profitable even at moderately low prices. But, in 1998, even offshore and Alaskan North Slope projects were canceled or delayed.

Use of the December 1998 oil prices to evaluate oil field economics forced many companies to write down proved reserves in some fields, even in the offshore. The December 1998 price (\$8.05 per barrel) was much tougher on smaller and marginal oil well operators as thousands of wells were shut in because they could not meet their direct operating costs, much less turn a profit. As a result, oil production and proved reserves dropped sharply in most lower 48 States areas. Texas' proved oil reserves fell 13 percent in 1998, which for the first time in a decade placed Texas second to Alaska in oil reserves.

In a sharp reversal from several years of increases, oil reserve additions dropped to less than a fifth of those in 1997. Reserve additions are the sum of *total discoveries* and *revisions and adjustments*. For crude oil, *revisions and adjustments* are usually larger than *total discoveries*, but they were a negative 120 million barrels in 1998. This was the first time in 22 years that *revisions and adjustments* did not make a positive contribution to oil reserve additions.

Total discoveries of crude oil were 599 million barrels in 1998, well under the prior 10-year average and less than half those of 1997. The Gulf of Mexico Federal Offshore and Alaska accounted for over 50 percent of them. *Total discoveries*, which equaled only 30 percent of 1998 oil production, are those reserves attributable to field *extensions*, *new field discoveries*, and *new reservoir discoveries in old fields*. They result from drilling exploratory wells.

- In a major reversal from 1997, *new field discoveries* were only 152 million barrels, less than a quarter of the 1997 level and well under the prior 10-year average. Most of the new field discoveries were in Alaska and the Gulf of Mexico Federal Offshore. Over half of the proved reserves of oil in the Gulf of Mexico are now located in deep water (water depths greater than 200 meters.)
- *New reservoir discoveries* in old fields were 120 million barrels, about the same as in 1997 but less than the prior 10-year average.
- Field *extensions*, down in 1998, added 327 million barrels of proved oil reserves.

Other 1998 crude oil events of note:

- The annual average domestic first purchase price for crude oil declined 37 percent for 1998 to \$10.88 per barrel.
- Exploratory oil completions were down about 30 percent at 303. Total oil well completions were down 32 percent at 7,064.
- Total discoveries per exploratory oil well were down 31 percent to an average of 1.98 million barrels per new exploratory well in 1998.

Looking ahead to 1999 on a more positive note for oil production and reserves:

- U.S. crude oil prices at the wellhead began increasing in March 1999, reached \$20 per barrel in September, and continue to rise. But oil drilling has not rebounded. Nevertheless, higher oil prices in December 1999 will bring back some of the oil reserves that became uneconomic in 1998.

Indicated additional reserves of crude oil decreased 1 percent to 3,160 million barrels in 1998. These are crude oil volumes that may become economically recoverable from known reservoirs through the application of improved recovery techniques using current technology. The presence of large indicated additional reserves in north Alaska, California, Texas, and Louisiana implies that significant upward revisions to crude oil proved reserves can occur in the future.

Natural Gas

The four-year increasing trend for U.S. natural gas proved reserves came to an end in 1998. Lower 48 States dry natural gas reserves also declined about 2 percent from the 1997 level. Even the Gulf of Mexico Federal Offshore proved reserves were down in 1998—dry gas reserves in the Gulf of Mexico Federal Offshore declined 5 percent in 1998. The reserve additions of natural gas were lower in 1998 because *total discoveries* were lower. The other component, *revisions and adjustments* (4,105 billion cubic feet) was about the same as in 1997.

U.S. *total discoveries* of dry gas reserves were 11,433 billion cubic feet in 1998, down 27 percent from 1997.

- *New field discoveries* were 1,074 billion cubic feet, less than half of the new field volume discovered in 1997 and 30 percent less than the prior 10-year average.
- Field *extensions* were 8,197 billion cubic feet, down from 1997 but still 19 percent above the prior 10-year average.
- *New reservoir discoveries in old fields* were 2,162 billion cubic feet, down 9 percent from 1997 and 7 percent less than the prior 10-year average.

Coalbed methane reserves and production continued to grow in 1998, despite the decline in reserves and production of conventional natural gas. Coalbed methane reserves accounted for 7 percent of 1998's proved dry gas reserves. Coalbed methane production in 1998 was 6 percent of the U.S. total dry gas production.

Other 1998 natural gas events of note:

- Exploratory gas well completions and total gas well completions both increased 7 percent in 1998.
- Although the number of wells increased, the average of total discoveries per exploratory gas well was 32 percent less in 1998.
- Natural gas prices at the wellhead fell 16 percent in 1998 to an annual average of \$1.94 per thousand cubic feet.
- U.S. gas production was also down in 1998, in keeping with lower natural gas demand.

Natural Gas Liquids

U.S. natural gas liquids proved reserves decreased 6 percent to 7,524 million barrels in 1998. A reassessment of natural gas liquids reserves in Alaska represents the bulk of the 1998 change.

Natural gas liquids reserves are the sum of natural gas plant liquids and lease condensate reserves.

Total proved reserves of liquid hydrocarbons (crude oil plus natural gas liquids) were 28,558 million barrels in 1998, a 6 percent decrease from the 1997 level. Natural gas liquids represented 26 percent of total liquid hydrocarbon proved reserves in 1998.

Data

These estimates are based upon analysis of data from Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," filed by 2,739 operators of oil and gas wells, and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production," filed by operators of 605 active natural gas processing plants. The U.S. proved reserves estimates for crude oil and natural gas are associated with sampling errors of less than 1 percent.